

# FUNDAMENTALS of THORACIC IMAGING: I, II

Chest Overview, Intro to Anatomy



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## Chest Curriculum Overview

- Fundamentals I and II
  - Terms, anatomy review
- Systematic review, Search Pattern
- Patterns, Differential diagnosis
  - Several sessions
- Basic cases
- CT mediastinum, lung
- Review

Overview

## Fundamentals I and II

- Terms, definitions
- Anatomy review, lines
- Approach (ID CD)
  - Identify abnormality
  - Describe abnormality (density, lucency, etc.)
  - Categorize or grade (extent, location, etc.)
  - Differential diagnosis (general and specific)

Overview

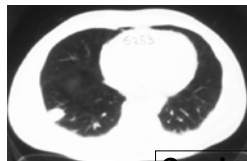
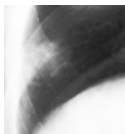
## Terms, definitions

- Terms Frequently Used and Misused
  - Edges, lines, stripes, densities, lucencies
- Normal Lung
  - Markings
- Demystifying the Lateral View
- The Airway

Overview

## Systematic Review, Differential Diagnosis

- Bulk of chest radiology, several sessions
- Ontology, matrix, how to analyze findings
  - Patterns, DDG, DDS



Overview

## Patterns

- Mass
- Consolidative
- Interstitial
  - Linear
  - Nodular
- Vascular
- Airway
  - Obstructive
  - Wall thickened

Overview

## Basic cases, CT

- Application of systemic review
- Go over cases of differing pathology
- Questions, quiz
- CT mediastinum, lung
  - Cross-sectional anatomy
  - Pathology
  - Workstation

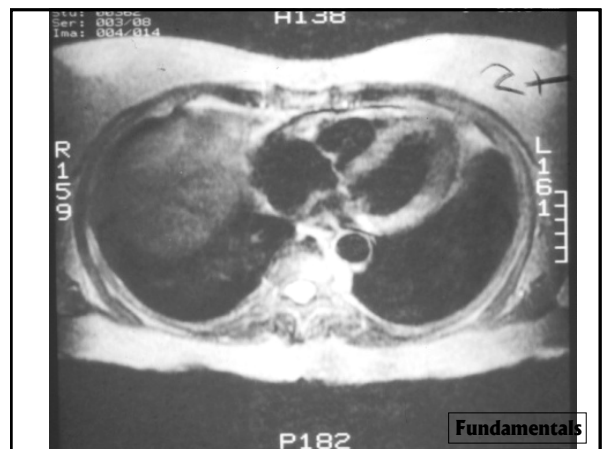
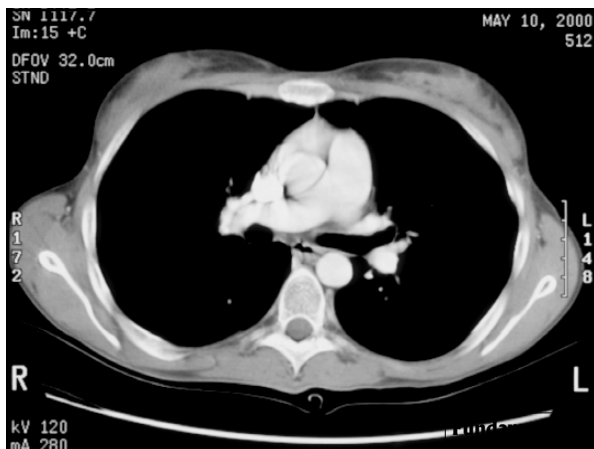
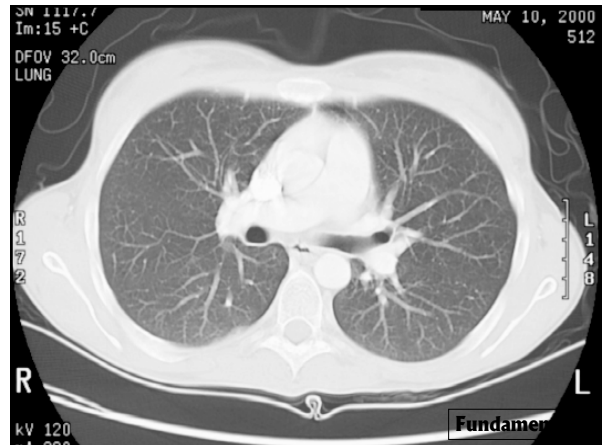
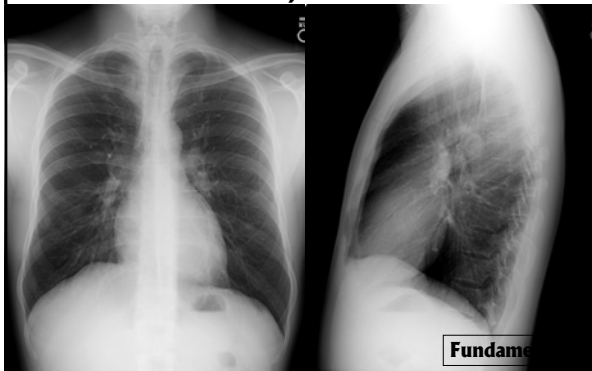
Overview

## FUNDAMENTALS of THORACIC IMAGING: I

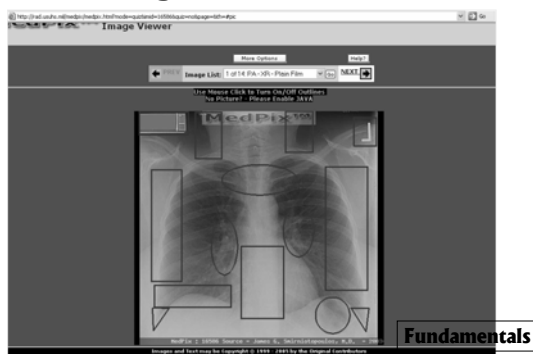
- Overview
  - Intro to chest imaging
  - Terms
  - Normal CXR anatomy, some CT
  - Hilum
  - Mediastinum
  - Lateral
  - Airway
  - Soft tissues

Fundamentals

## PA + Lateral CXR AKA: Plain Films, Frontal + Lateral



## MedPix: great source for CXR



• <http://rad.usuhs.mil/radpix/medpix.html?mode=quiz&imid=16586&quiz=no&page=&itn=fpic>

## Chest Review on MedPix



• [http://rad.usuhs.mil/rad/chest\\_review/index.html](http://rad.usuhs.mil/rad/chest_review/index.html)

## Terms Frequently Used (and often Misused)

**SHADOW** - Anything visible on an image; hence, any specific density or lucency

**EDGE** - Any visible demarcation between a density on one side and lucency on the other

**LINE** - A thin density with lucency on both sides or a thin lucency with density on both sides

**STRIPE** - Either edge or line

**Terms**

**DENSITY** - Whiteness, or any area of whiteness, on an image (opacity)

**LUCENCY** - Blackness, or any area of blackness, on an image

**“Rules of Visibility”**

The edge of a structure is only visible if it is bordered by a structure of different density

Imaging densities include soft tissues (including, blood/fluid), fat, calcium and even air (low density).

**Terms**

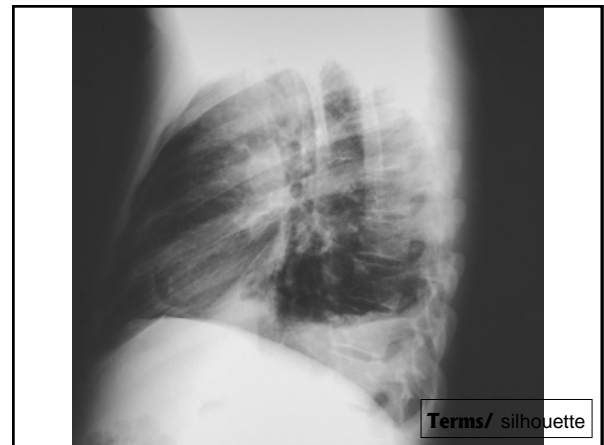
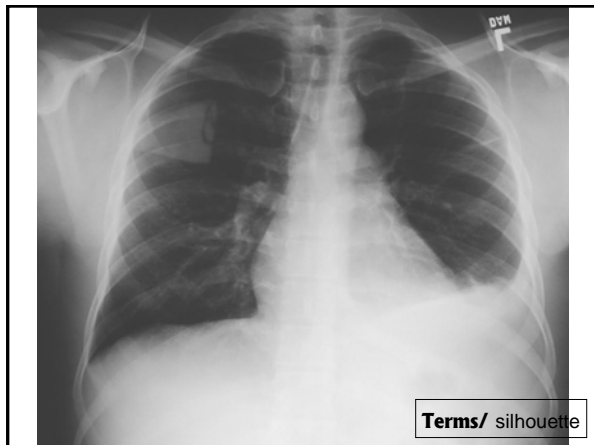
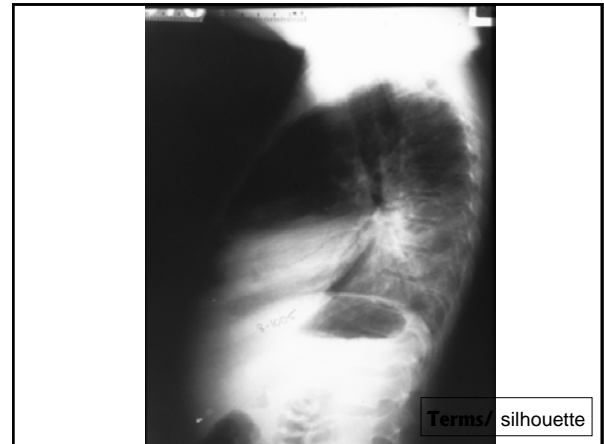
## Descriptor Terms

- SILHOUETTE** - Synonym for edge;
  - loss of an edge constitutes the “silhouette sign”
- Location** (i.e. anatomic)
- Adjacent to...**
- Surrounded by...** (think radiology)
- Conspicuity** (con-spe-CUE-e-tee)
  - degree of “conspicuous-ness”
- Pattern**
  - Mass, consolidate, infiltrate, vascular, airway

**Terms**



**Terms**



## Radiological Airway Anatomy

- The trachea is visible on both frontal and lateral views because it is adjacent to soft-tissues
- The main bronchi are visible within the mediastinum and the medial portion of the hilum
- Once a bronchus is surrounded by air-filled alveoli, it becomes invisible because nearly all normal bronchial walls are too thin to be visible lines

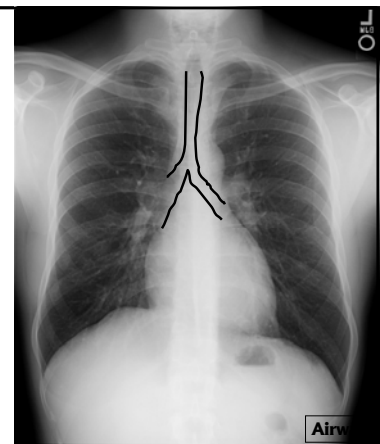
Airway

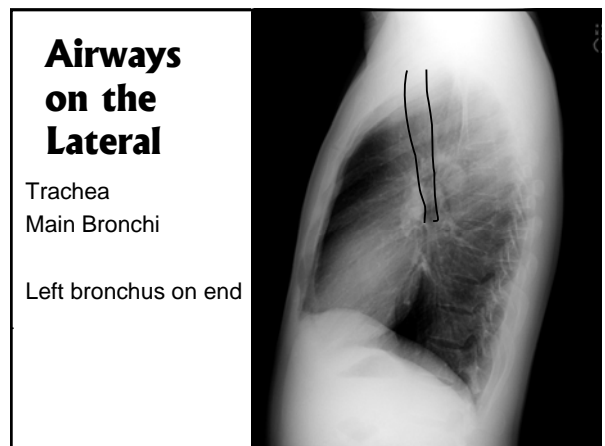
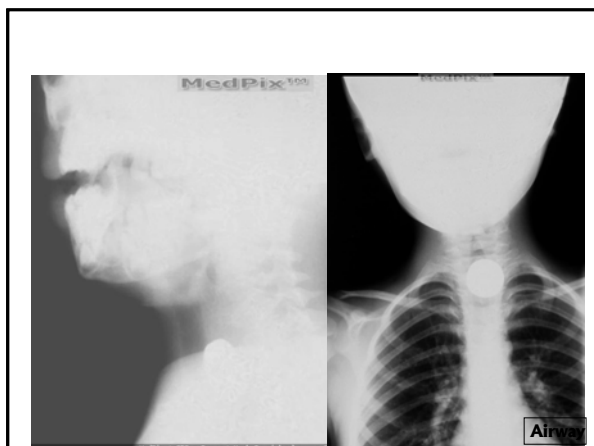
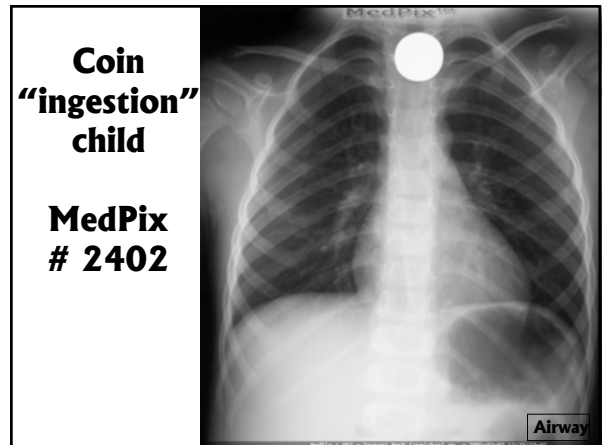
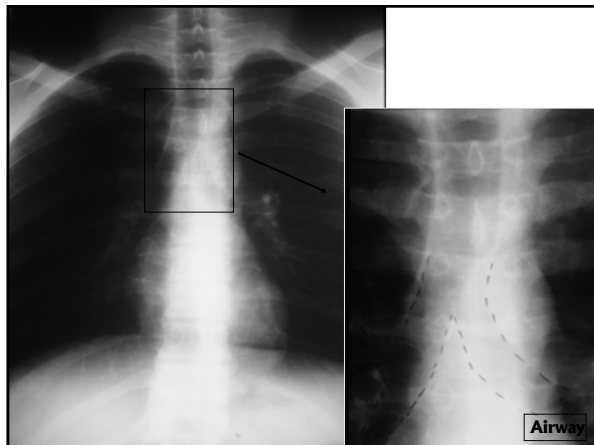
## Airways

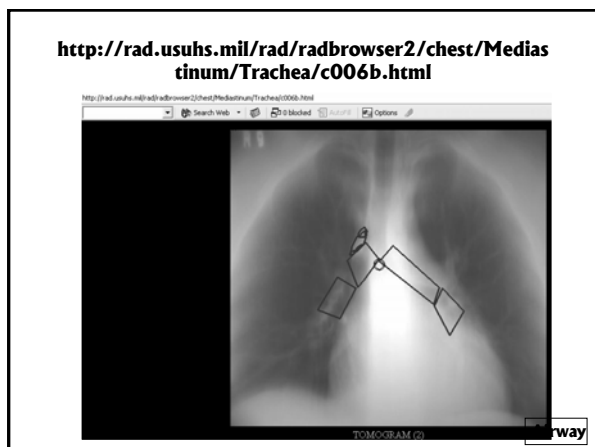
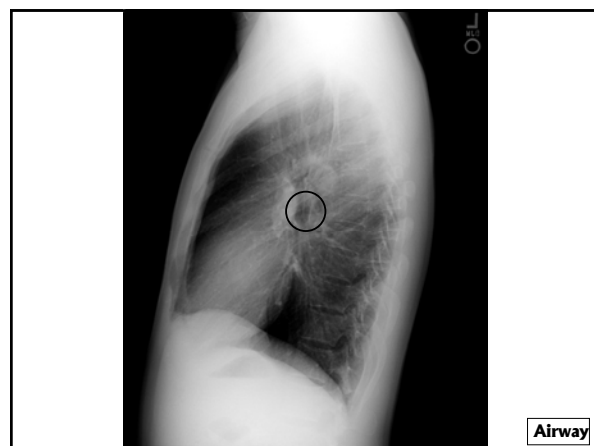
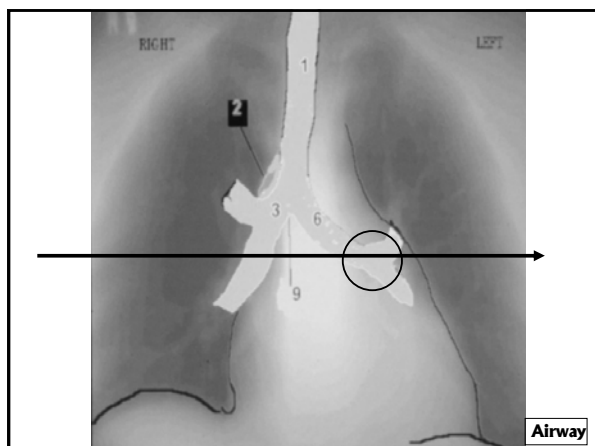
Trachea

Carina

Main Bronchi







## Demystifying the Lateral View

The air column, which includes the trachea and largest bronchi, is visible because it is adjacent to soft tissue

The carina is not visible on the lateral view because the main bronchi continue in the same direction as the trachea

The round lucency in the center of the lateral view is the distal portion of the left main bronchus as it becomes horizontal

Lateral

## Normal Hilum

The anatomic connection of the lung to the mediastinum and therefore consists of a variety of vessels, bronchi, and lymph nodes.

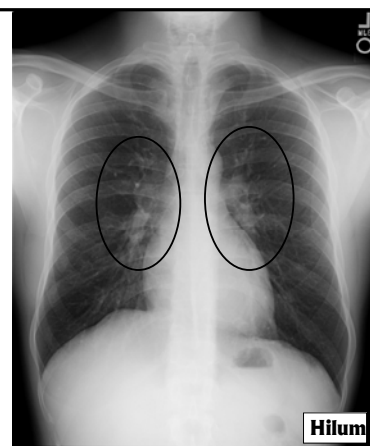
- The visible portion of each normal hilum is the right or left pulmonary artery. The pulmonary veins are inferior and posterior to the arteries, behind the edges of the heart on the frontal view and overlapping many other structures on the lateral view. The major bronchi are visible as lucencies. The lymph nodes are too small to be visible when normal.
- The right and left pulmonary arteries are clearly visible on the lateral view, in the center of the image. The right pulmonary artery is just anterior the air column (trachea continuous with main bronchi) and the left pulmonary artery is just posterior.

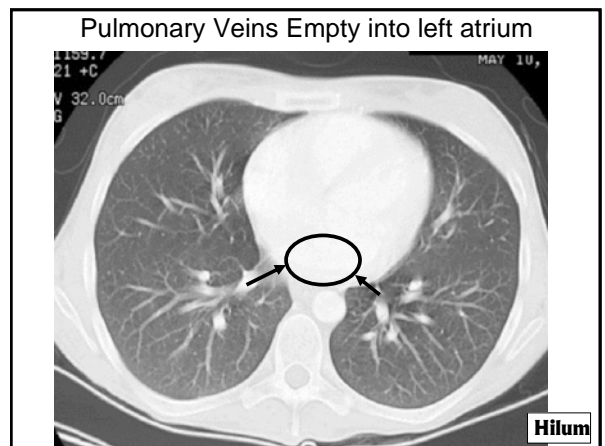
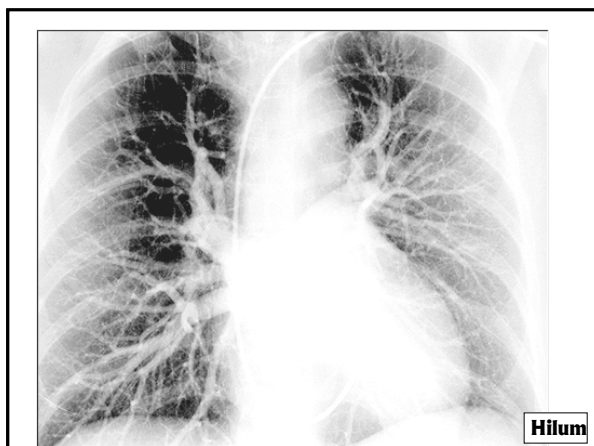
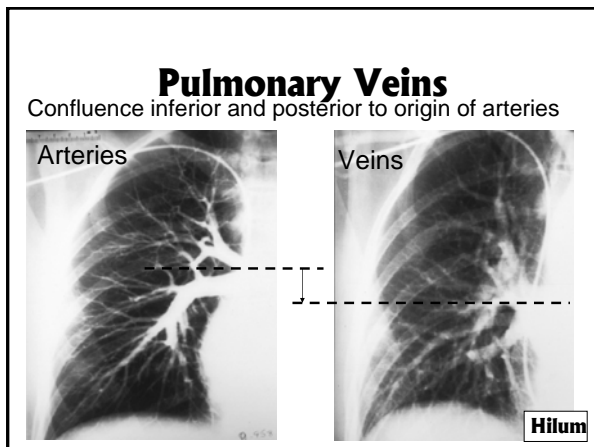
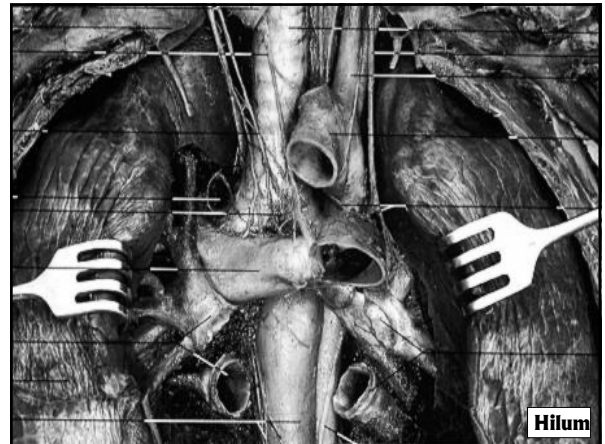
Hilum

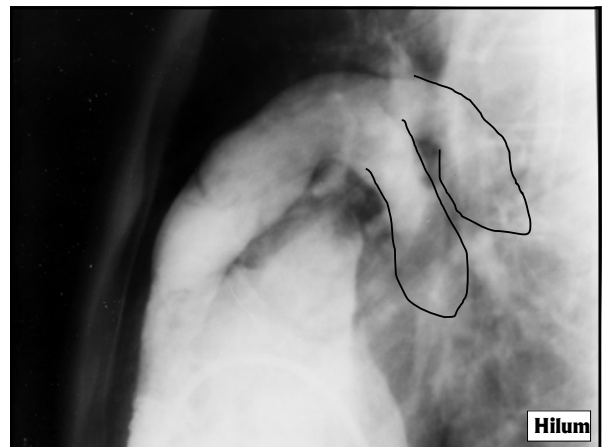
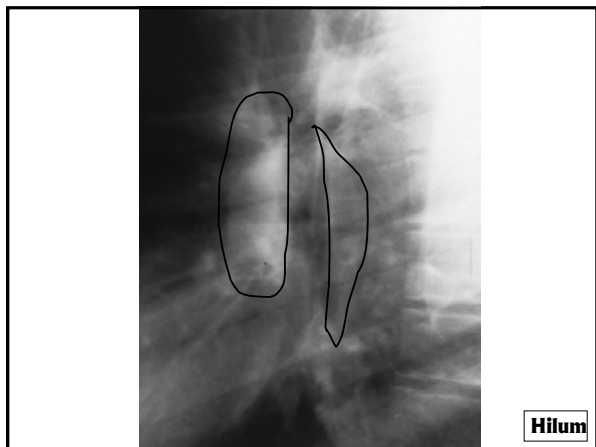
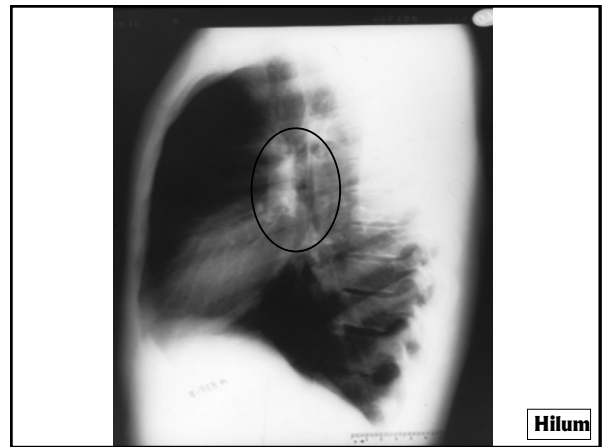
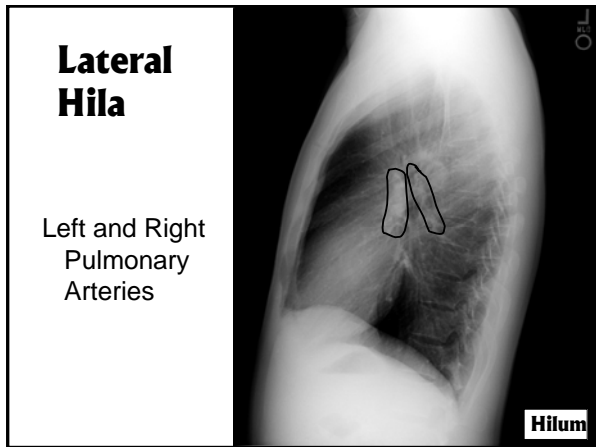
## Hila

Pulmonary Arteries

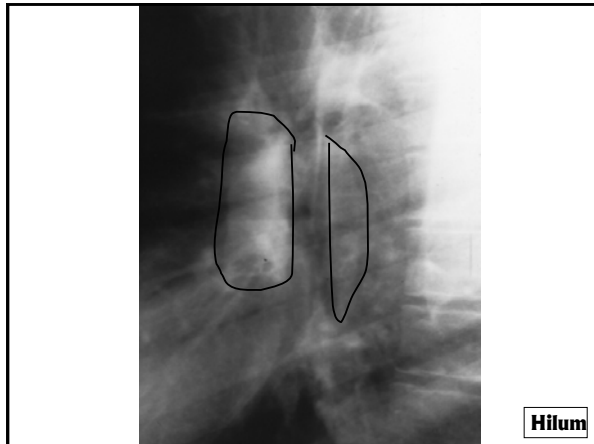
Review







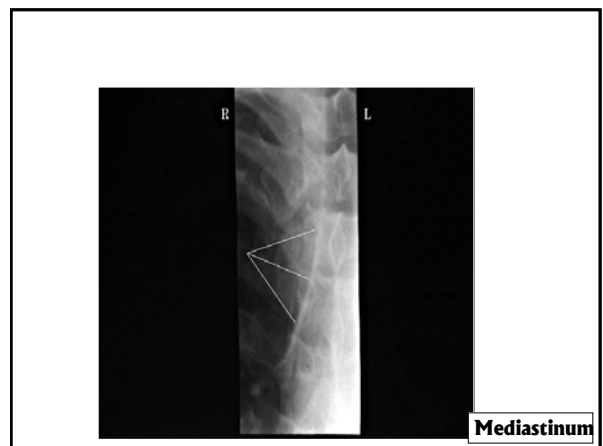
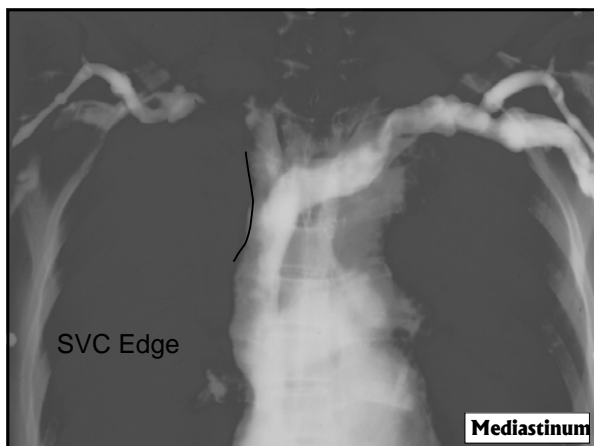
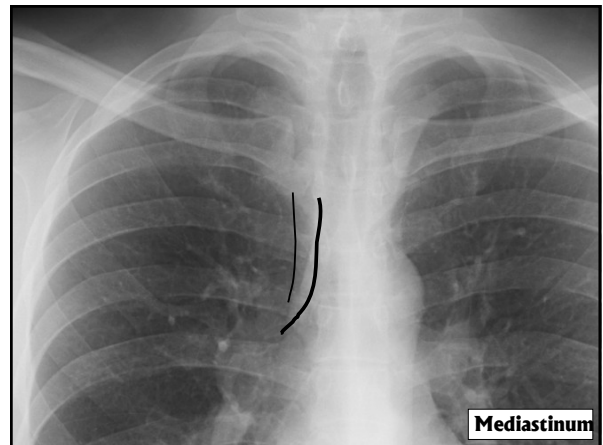
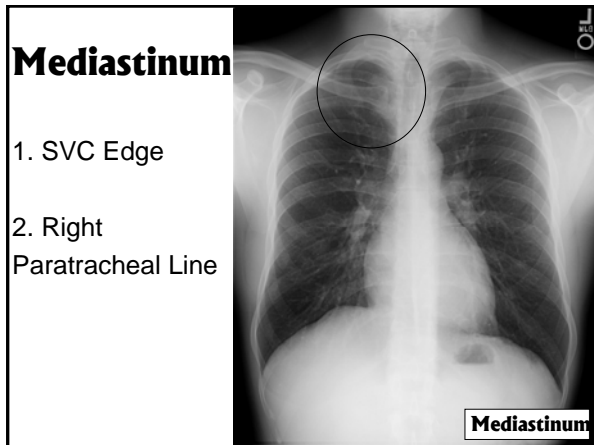


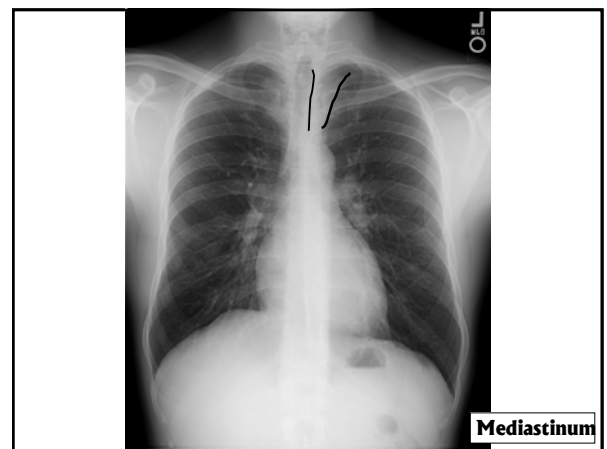
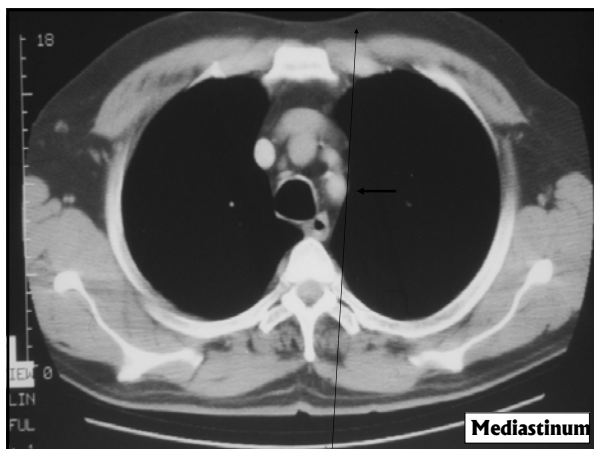
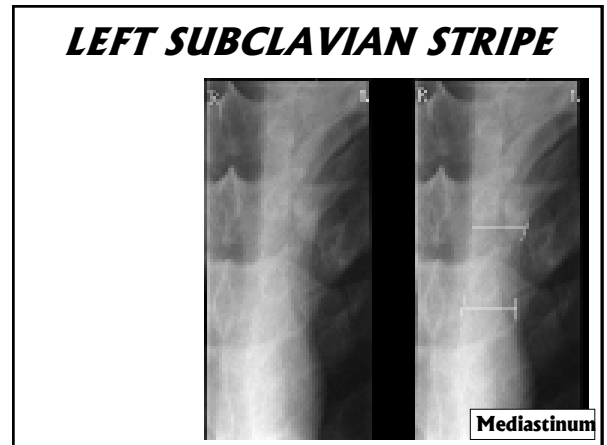
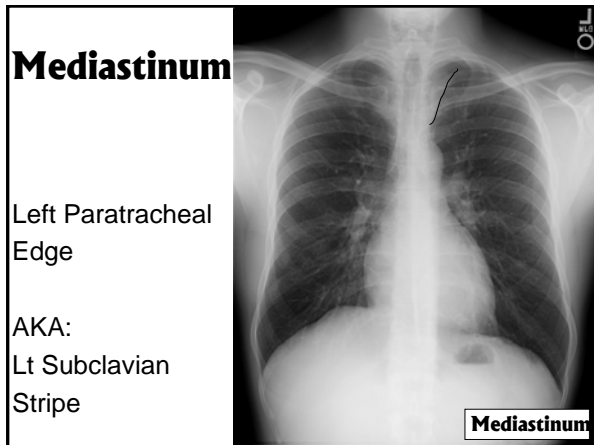
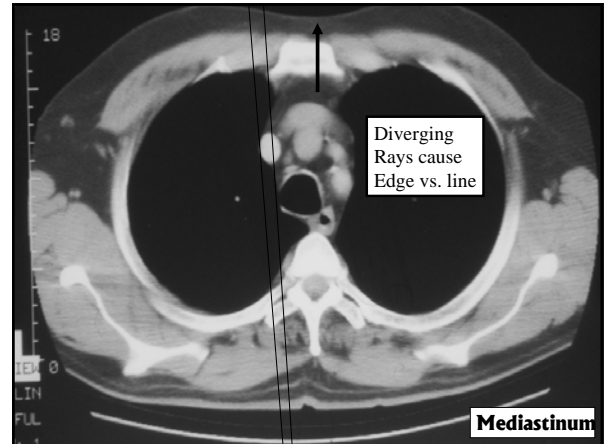
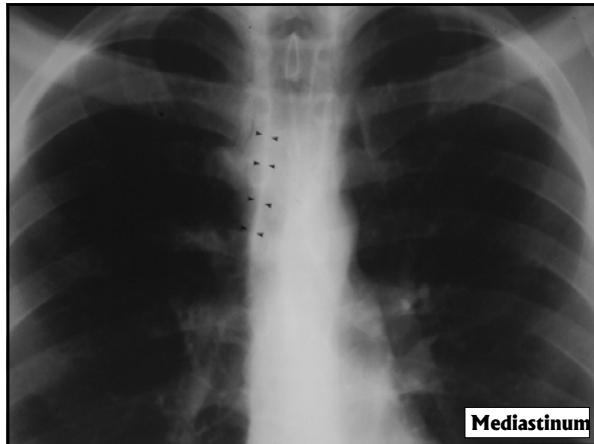


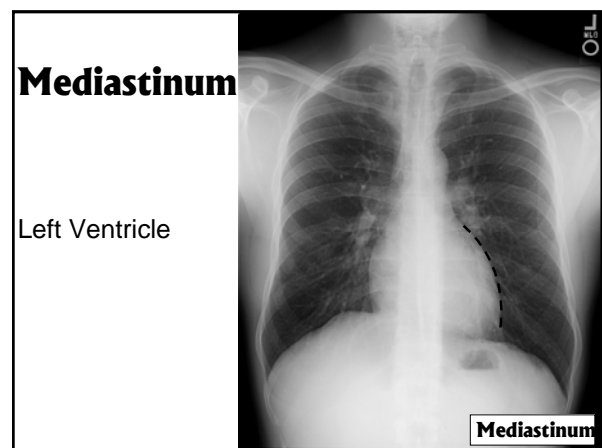
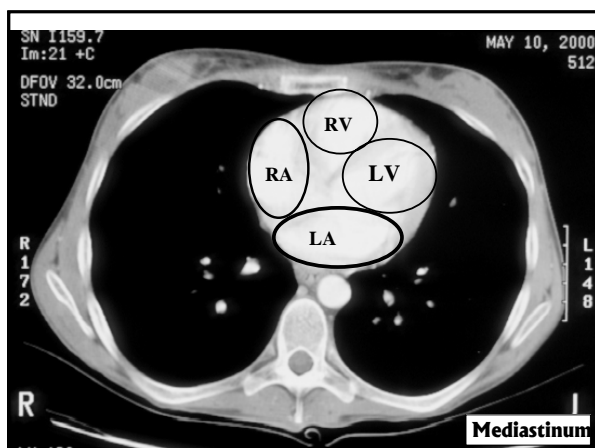
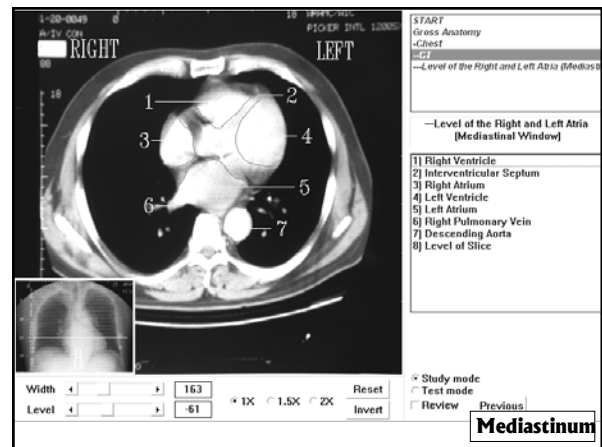
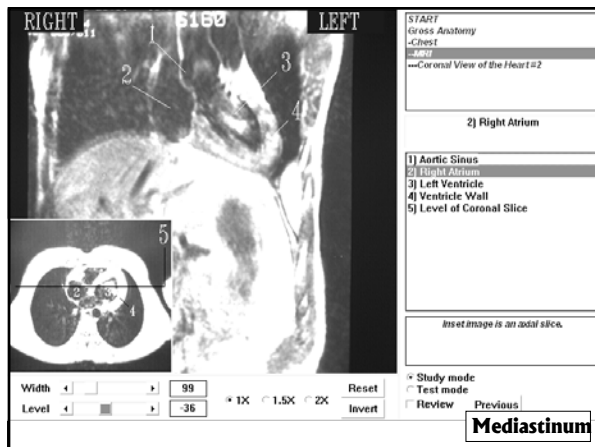
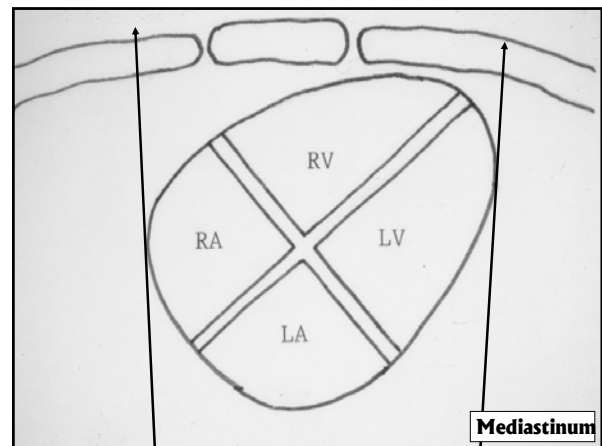
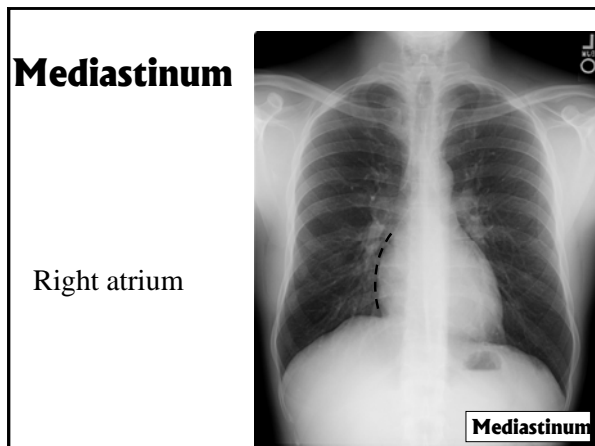
## Normal Lung Markings

- The only normal densities within the lungs are the pulmonary vessels when filled with blood.
- Normal pulmonary markings (vessels) can be followed from the hilum toward the lung periphery in all directions. They branch at acute angles, taper and diverge toward the periphery.
- Pulmonary markings on end appear as small masses or nodules. They are recognized as normal vessels by the fact that they are superimposed upon vessels of the same diameter branching in other directions.
- They are also larger toward the hilum and similarly sized to vessels nearby

Lung Markings

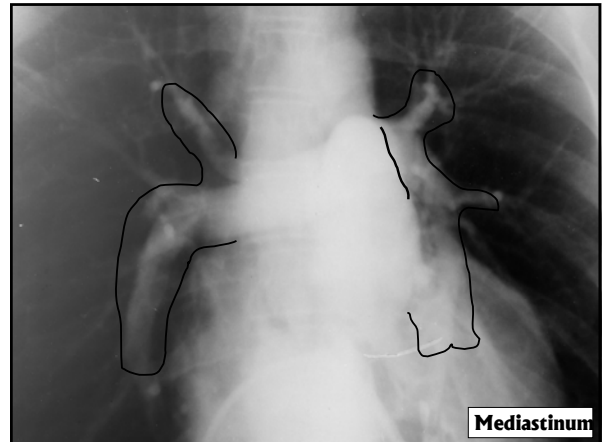






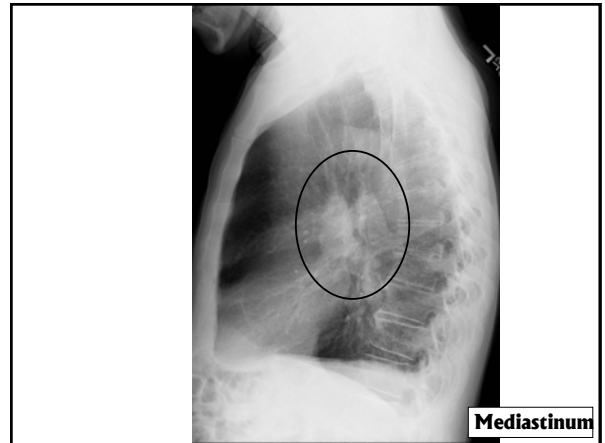
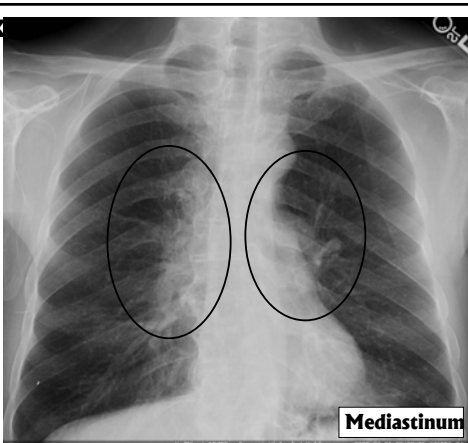
## Mediastinum

"Middle mogul"  
Main Pulmonary  
Artery  
(Trunk)



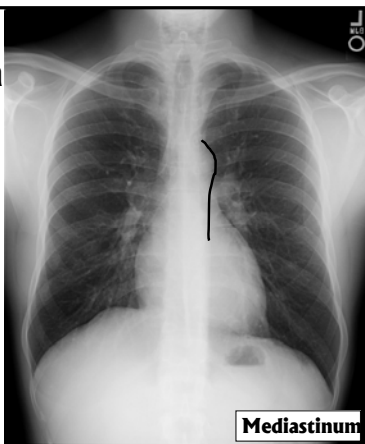
MedPix  
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PAH



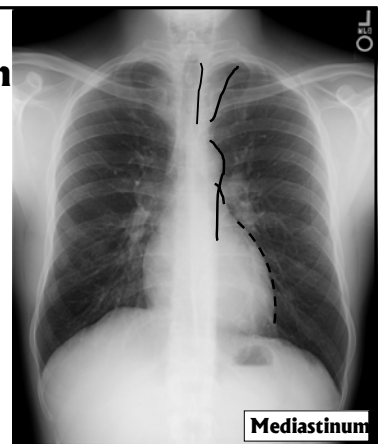
## Mediastinum

Aortic Knob  
Descending Aorta



## Mediastinum

Review: Left

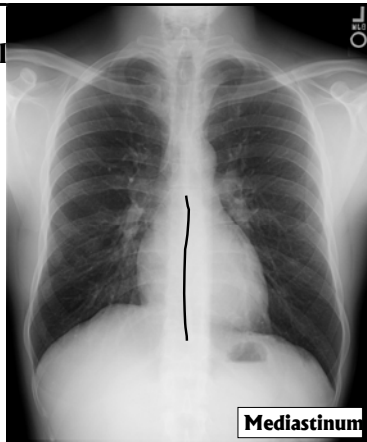


### Azygo-esophageal Edge

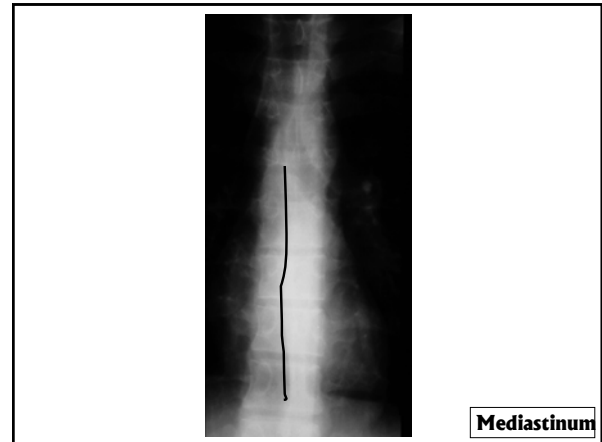
Midline, vertical

Lucent on right, dense on left

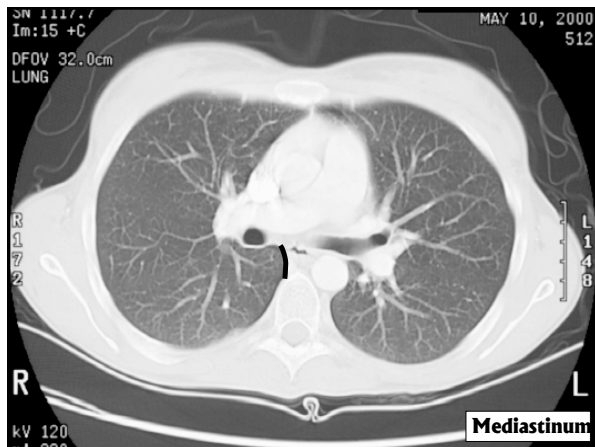
Most medial margin of right lung



Mediastinum



Mediastinum

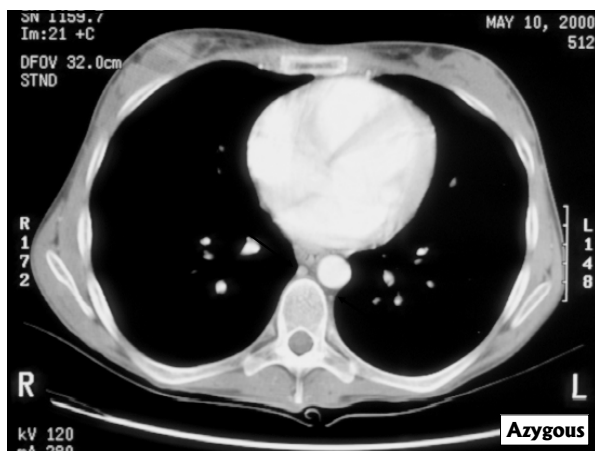


Mediastinum

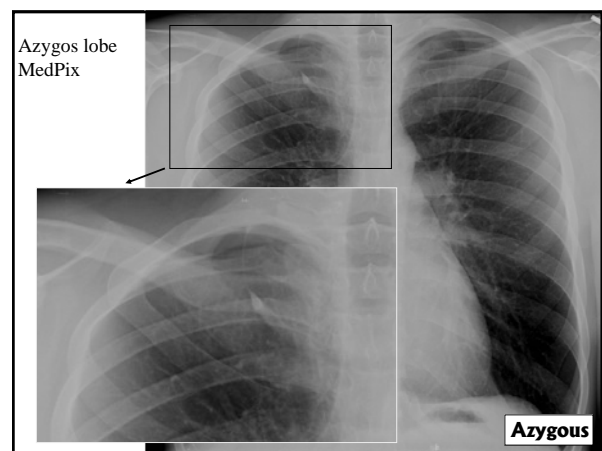
### Azygous System

- Arch of azygous
  - enters posterior SVC
  - above right main bronchus
  - around right side of trachea
- Azygous vein
  - right and posterior to esophagus
  - anterior to spine
- Hemiazygous – left

Azygous



Azygous



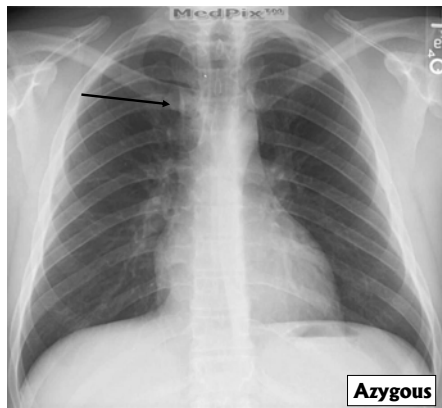
Azygos lobe  
MedPix

Azygous

**MedPix  
5064**

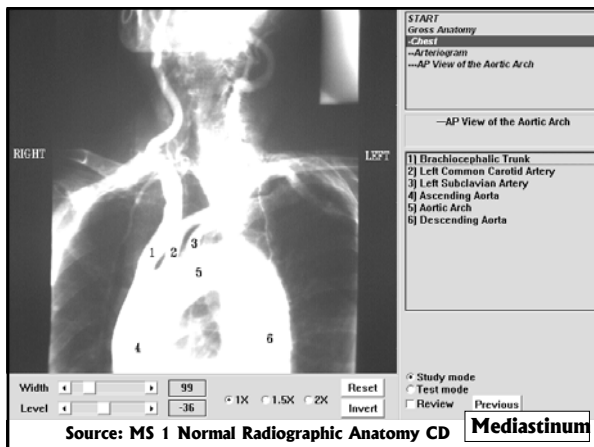
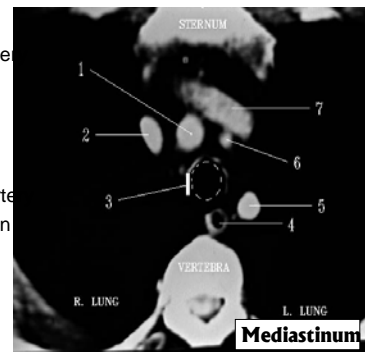
Azygos  
lobe

Normal  
variant



## Mediastinal Vessels

1. Rt Brachiocephalic Artery
2. Superior Vena Cava
3. Rt Paratracheal Stripe
4. Esophagus
5. Lt Subclavian Artery
6. Lt Common Carotid Artery
7. Lt Brachiocephalic Vein



## Findings/ Dx

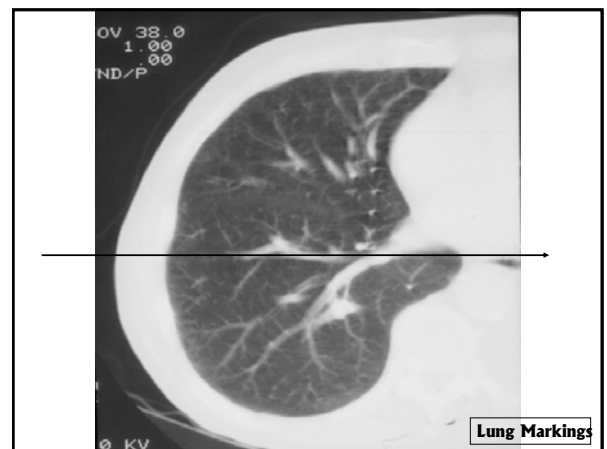
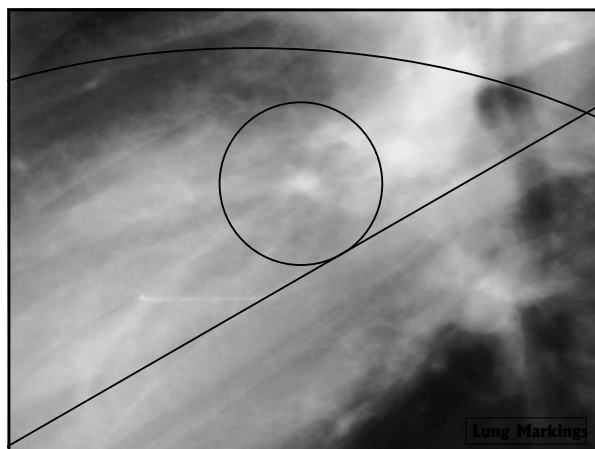
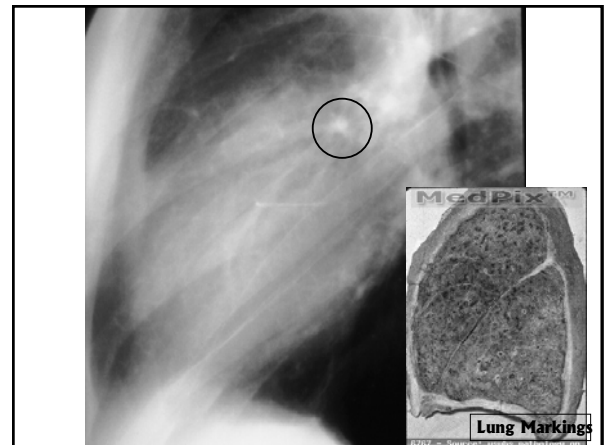
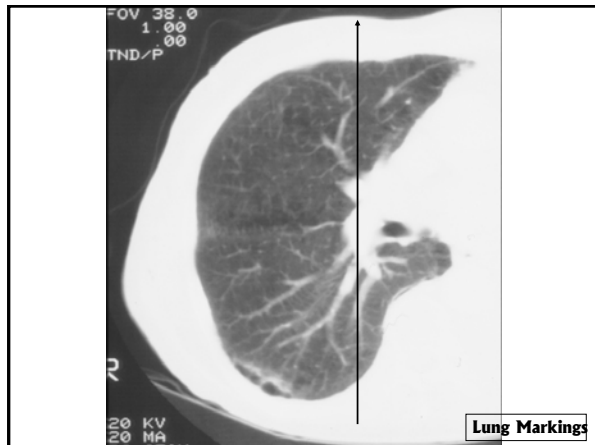
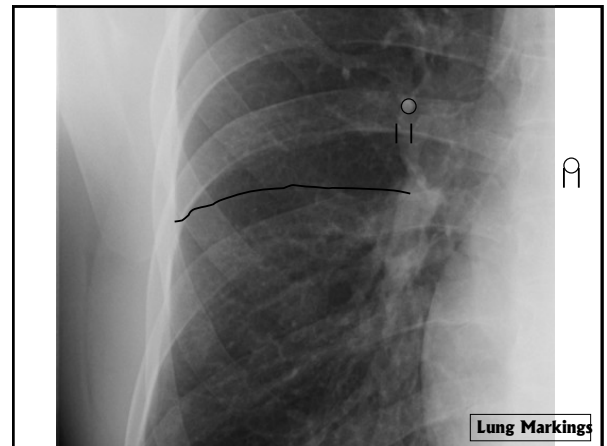
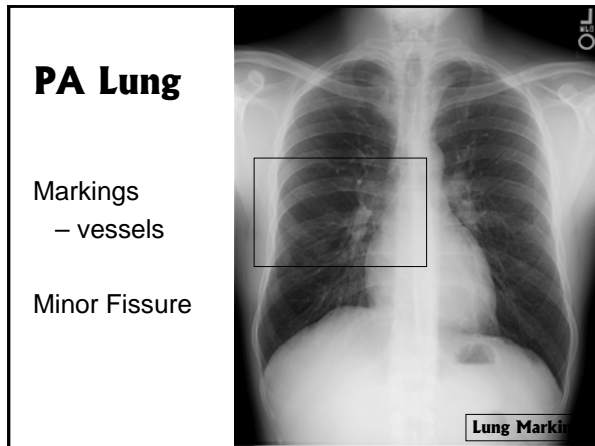
- A dilated, mildly tortuous esophagus filled with a fluid-debris mixture is evident on both the PA and lateral images. No other imaging studies are available for comparison.
- Achalasia (of various etiologies)
  - Esophageal Obstruction
  - Esophageal cancer
  - Gastric cancer
- Confirmed by:
  - Further history was obtained and it was found that patient has a long history of achalasia.

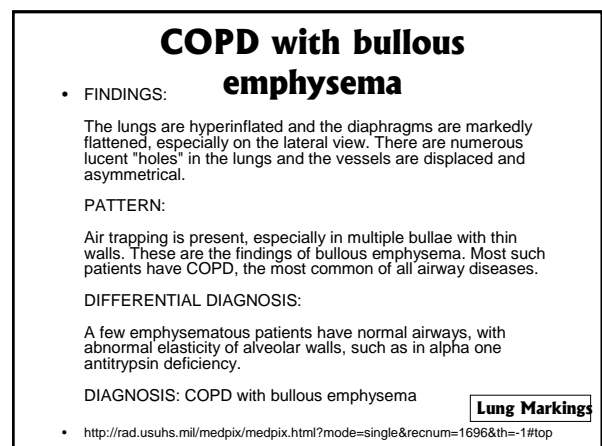
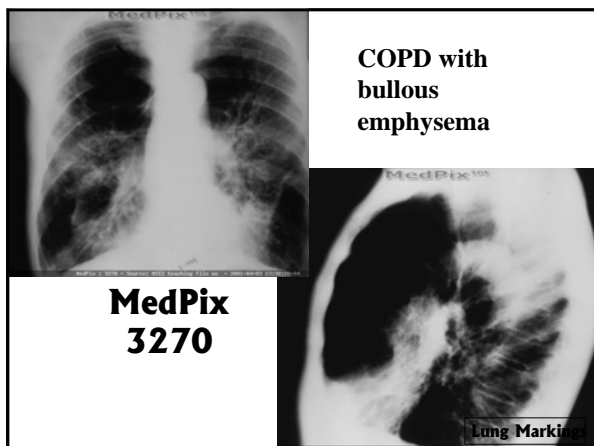
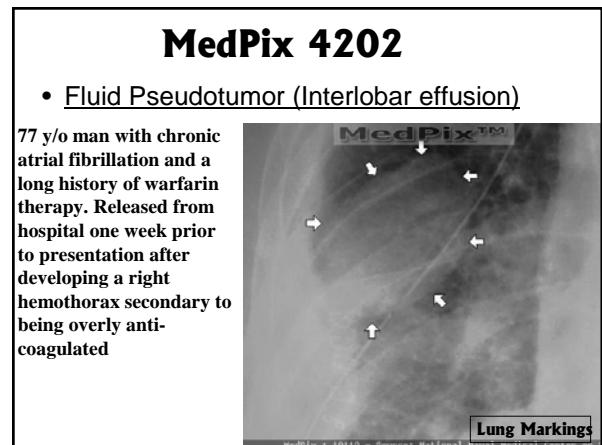
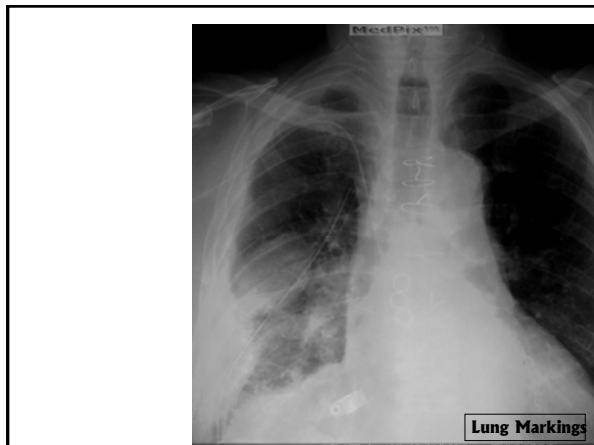
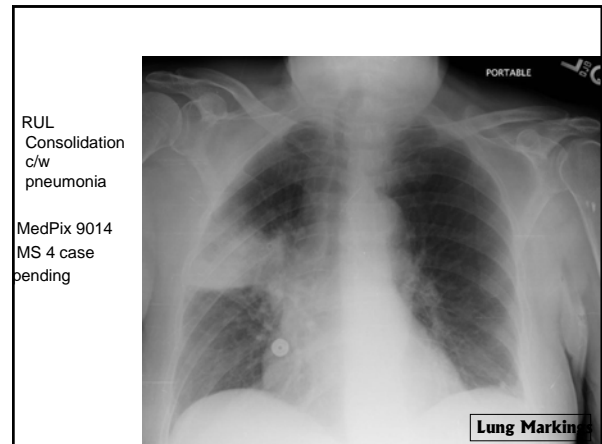
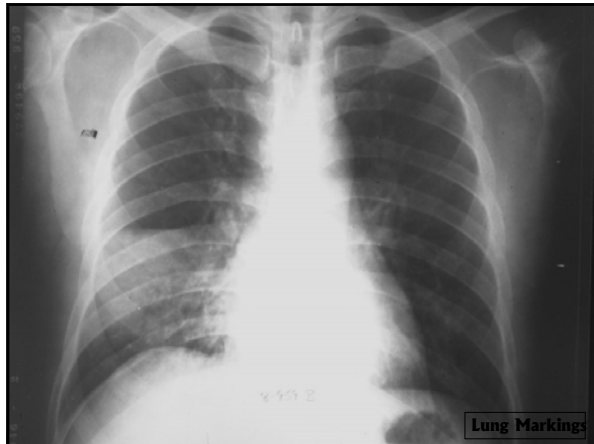
## Abnormal Lung Markings

Abnormal pulmonary markings are any shadows in addition to the normal markings

Many such shadows obscure the normal markings or displace them

**Lung Markings**







## Demystifying Lateral View

### The heart shadow

The only margin of the heart that is visible as a distinct edge is the back of the left ventricle because it borders the left lower lobe of the lung

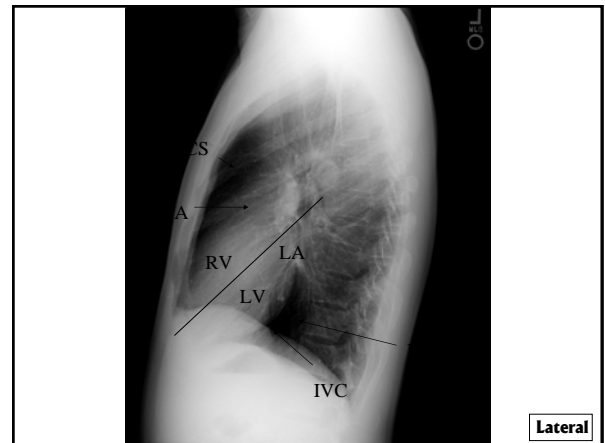
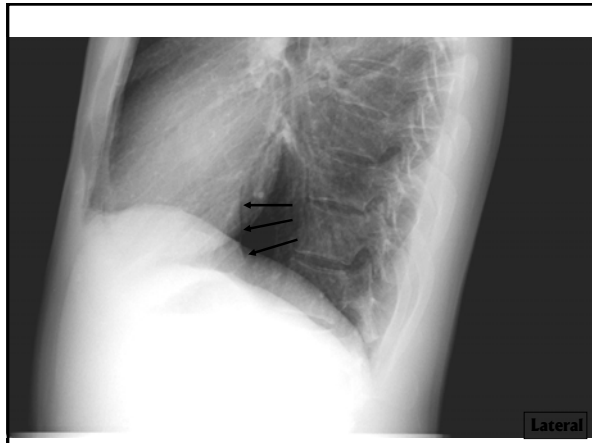
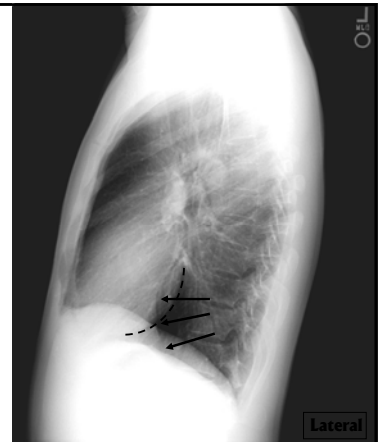
The top of the heart shadow is never a distinct edge because the pulmonary artery and aorta, rather than lung, are directly above the heart

Lateral

## Lateral Heart

Left Ventricle  
(curved line)

IVC  
(arrows)



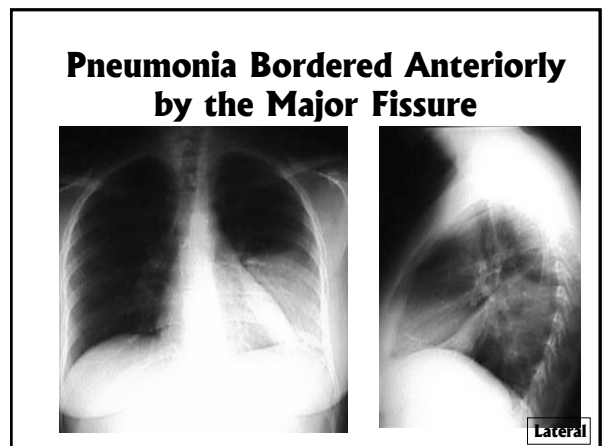
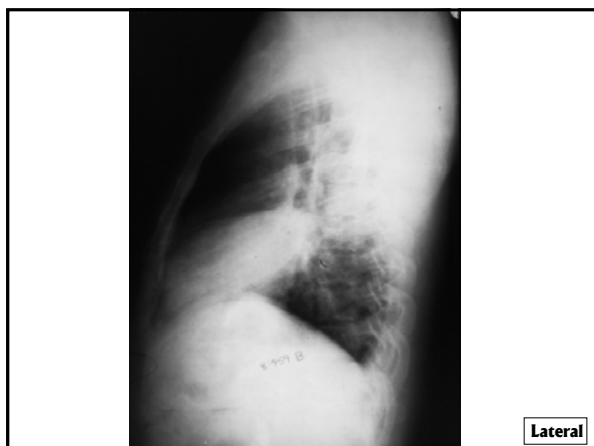
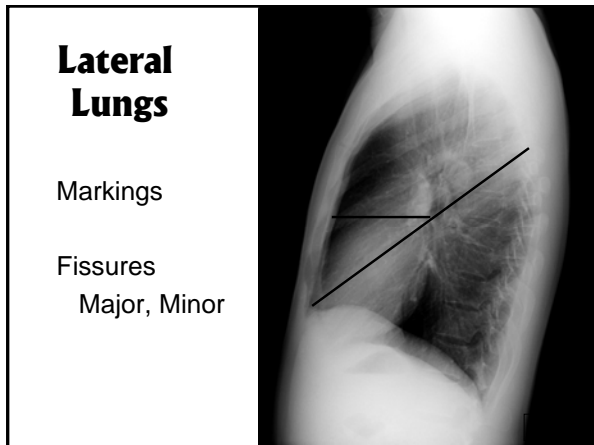
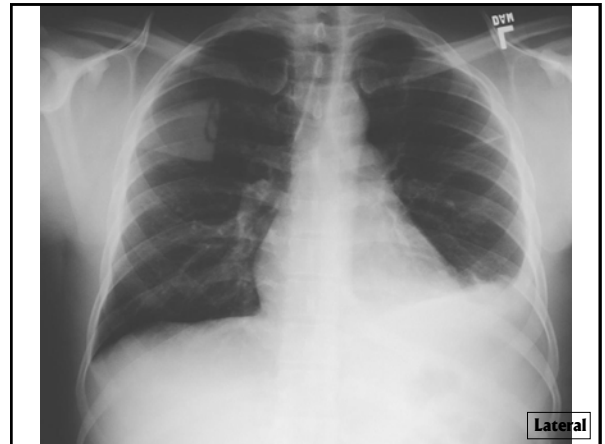
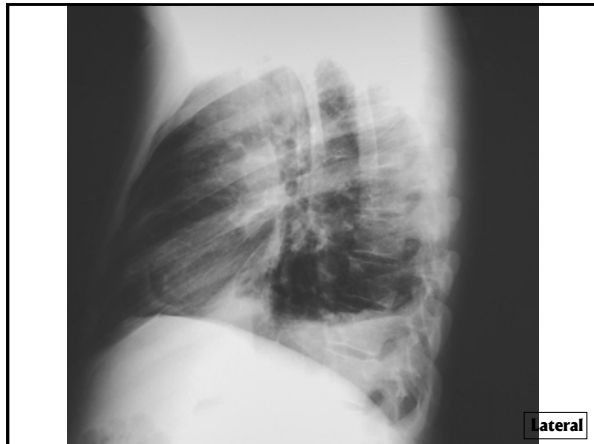
## Lateral View

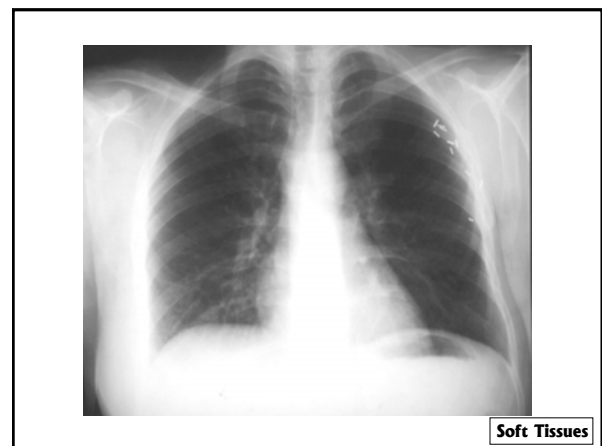
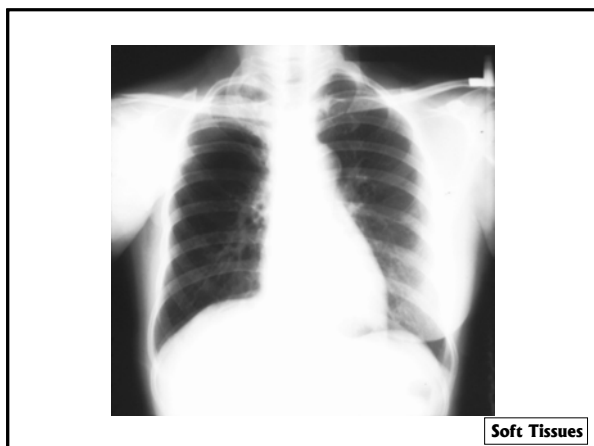
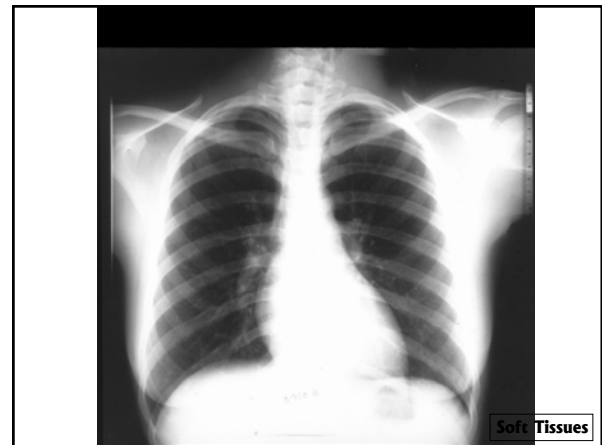
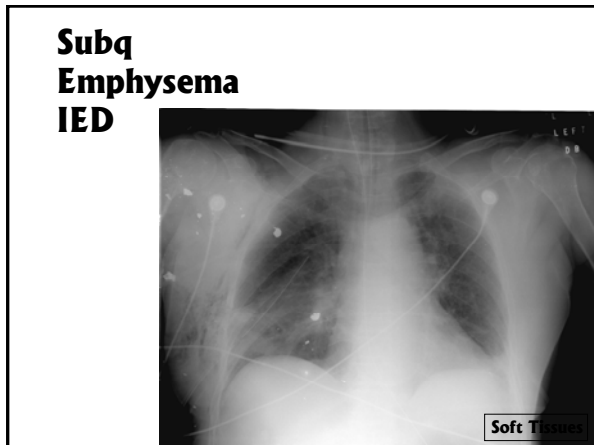
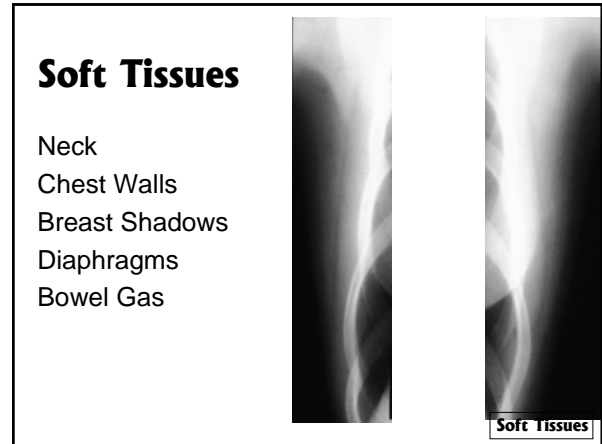
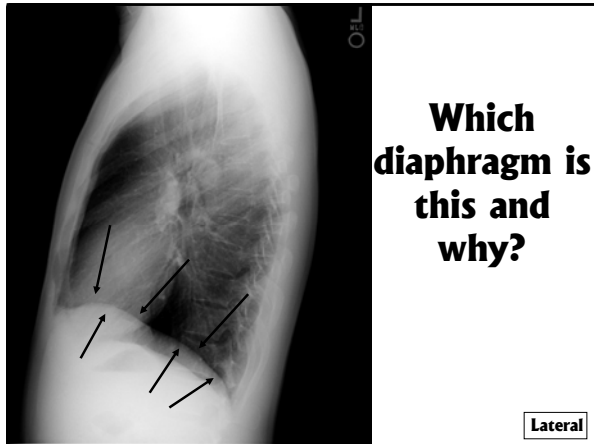
The relative lucency above the heart shadow is caused by the relative thinness of the mediastinum in that region

The thoracic spine should appear increasingly lucent from top to bottom, until it crosses the diaphragms.

Lateral

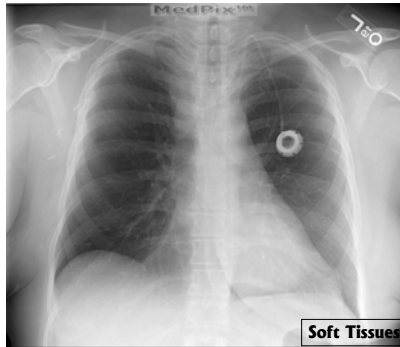




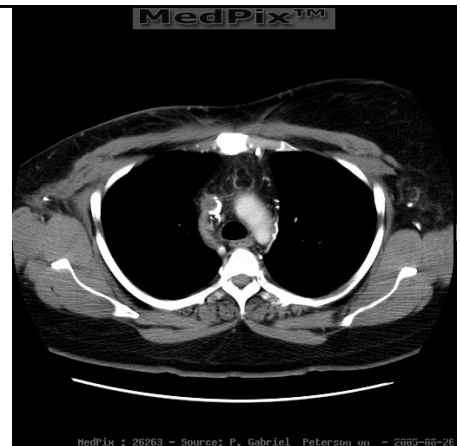


## Putting it all together: MedPix COW 8768

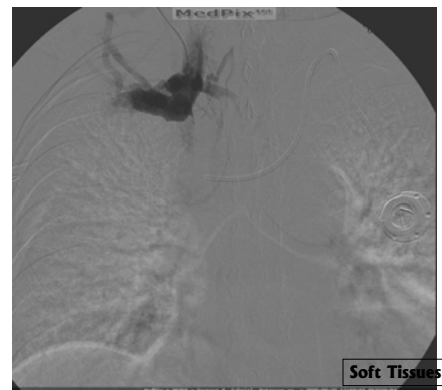
- 43 yo F 5-day hx bilateral facial, neck, and upper extremity swelling
- Also episodes of dizziness and syncope.



- Homogeneous filling defect in the SVC consistent with venous thrombosis



- Homogeneous filling defect in the right brachiocephalic vein consistent with venous thrombosis demonstrating complete occlusion.



## More hx: Patient Specific Discussion:

- (Also Read the Disease Discussion) This patient was diagnosed with poorly differentiated infiltrating ductal carcinoma and subsequently treated with a right modified radical mastectomy approximately 4 months prior to current admission.
- A right-sided indwelling central catheter had been in place for approximately 3.5 months and the patient was status-post 6 cycles of doxorubicin and cyclophosphamide (AC) chemotherapy.

Soft Tissues



### **SVC Syndrome secondary to central catheter-related venous thrombosis.**

CT confirms etiology as venous thrombosis. Venography confirms SVC syndrome by demonstrating 1) complete occlusion of the SVC and 2) opacification of a dilated collateral, the azygos vein. **Treatment and Followup:** This patient was treated with local thrombolysis via catheter infusion of tissue plasminogen activator (tPA) as well as multiple percutaneous transluminal angioplasties (PTA) over the course of 3 days.

Ultimately endovascular mechanical thrombectomy in combination with PTA yielded the final result.

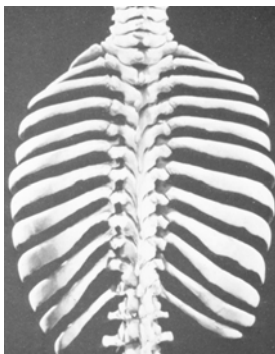
Soft Tissues

### **Bones**

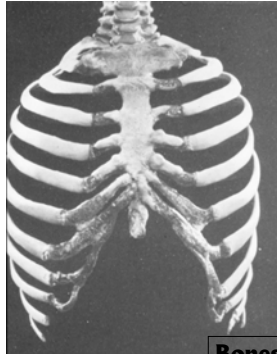
Ribs (Anterior and Posterior)  
Clavicles  
Scapulae  
Humeri  
Spine  
Pedicles  
Spinous and transverse processes

Bones

#### **Posterior**

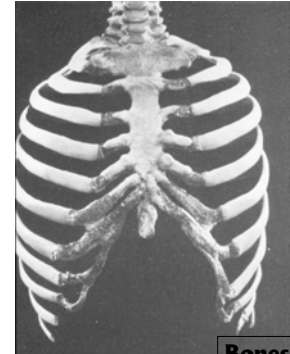


#### **Anterior**



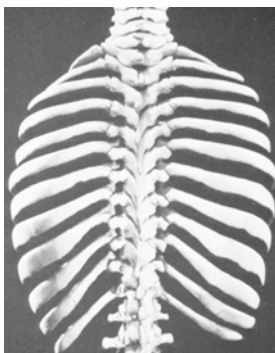
Bones

**Anterior:  
Ribs angle  
down from  
periphery**

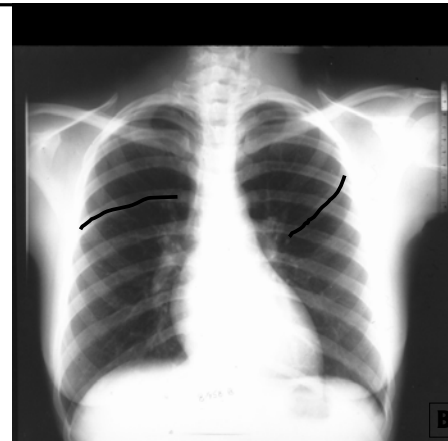


Bones

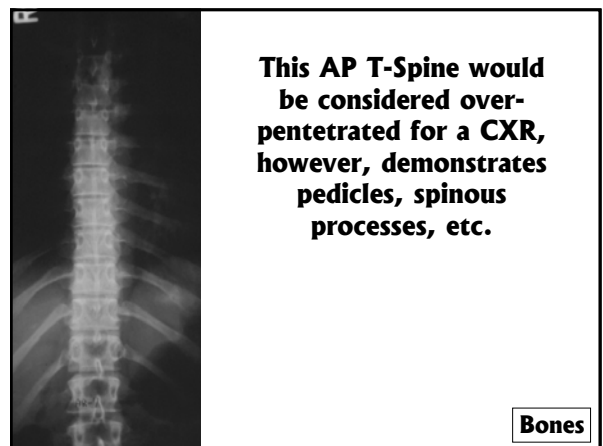
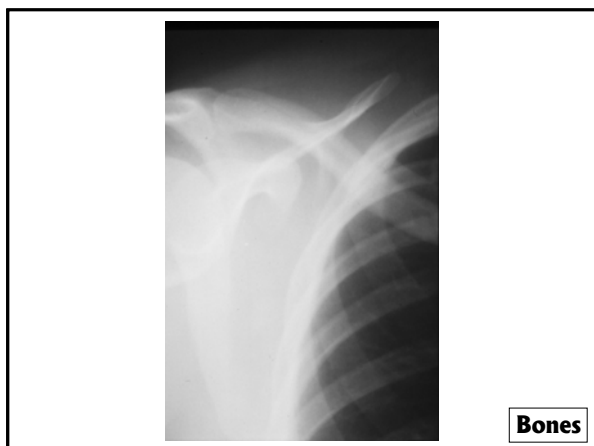
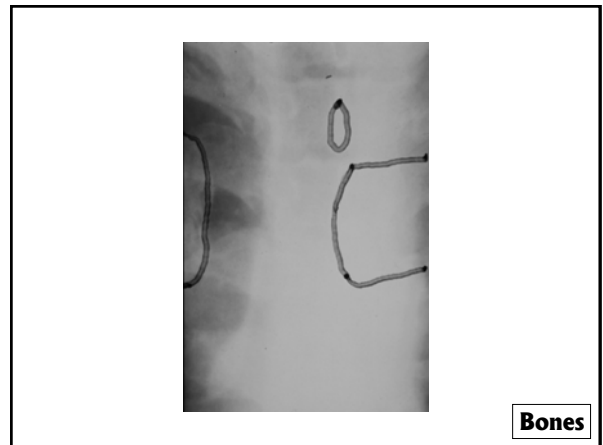
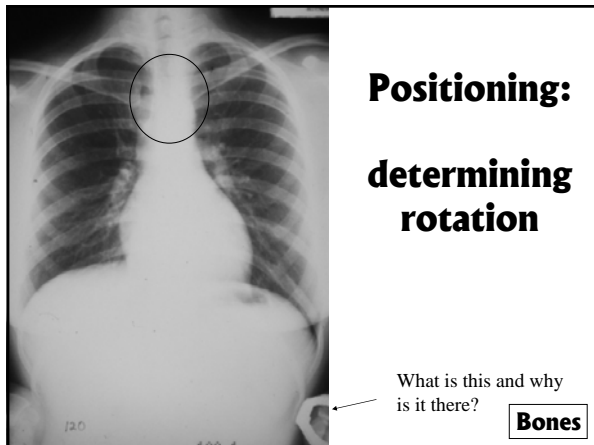
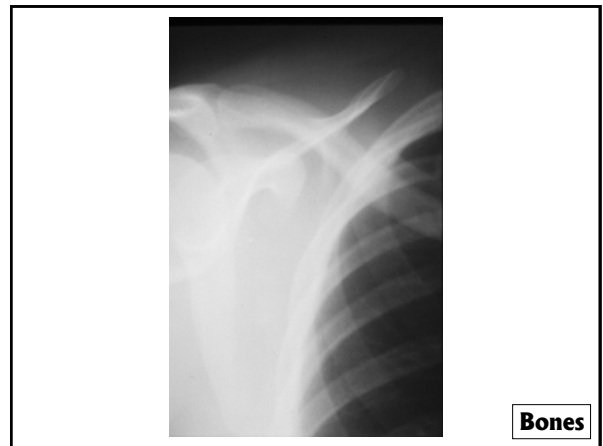
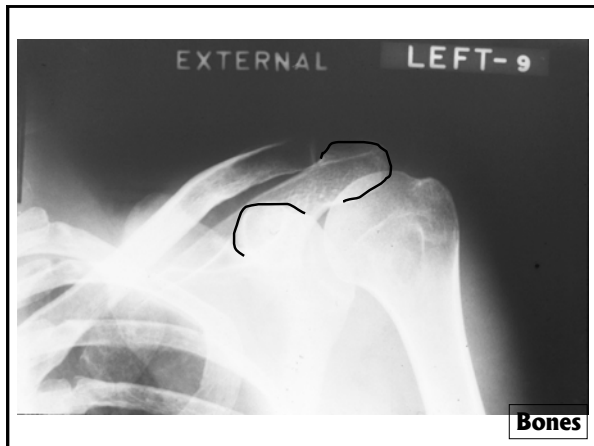
**Posterior  
Ribs angle  
down from  
center**

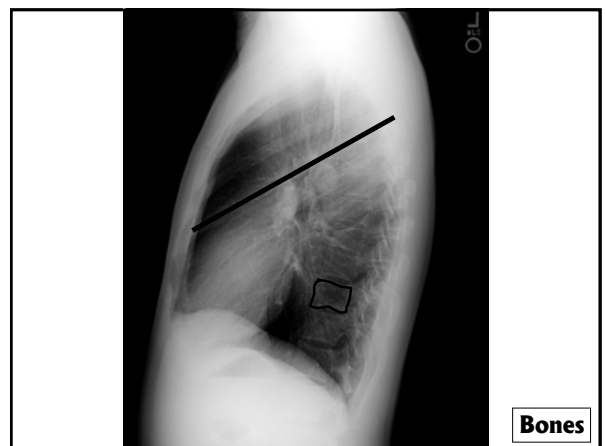
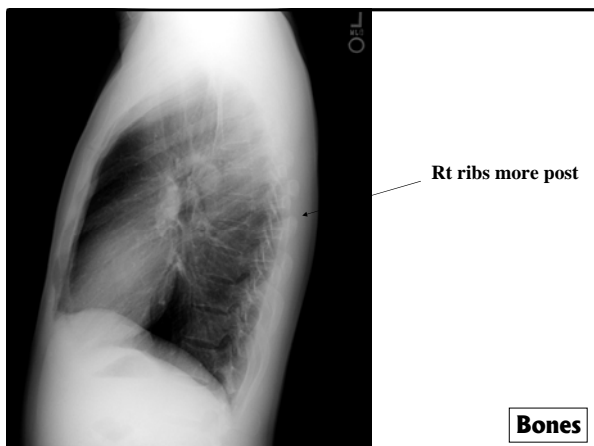
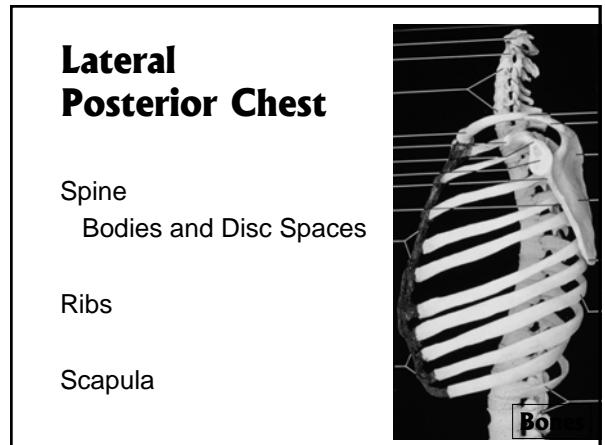
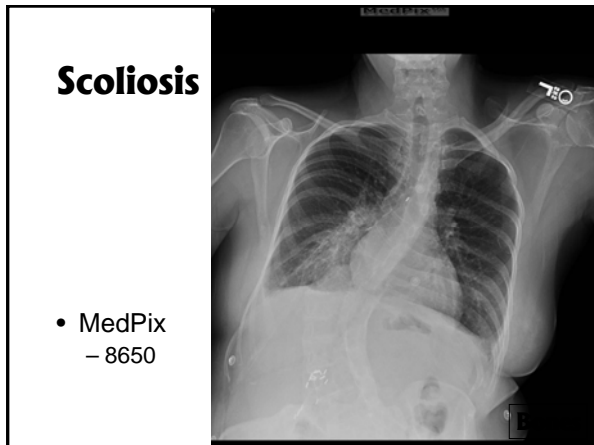
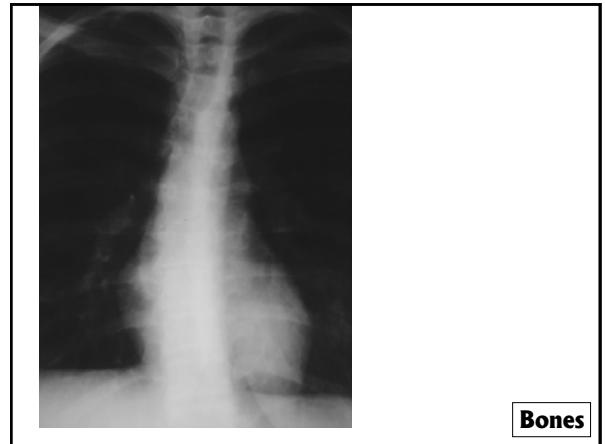
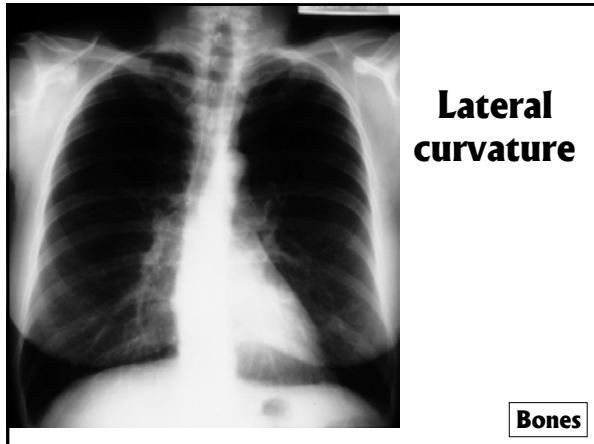


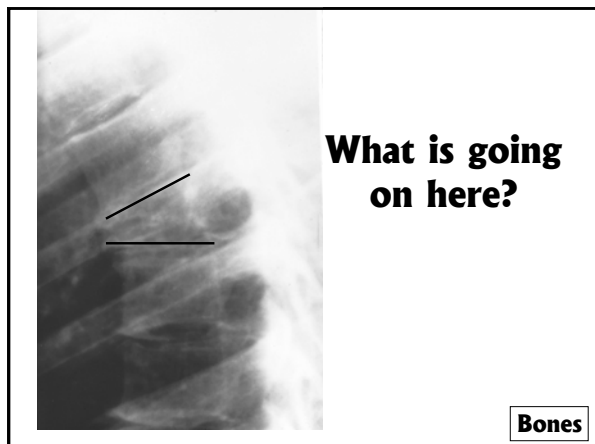
Bones



Bones

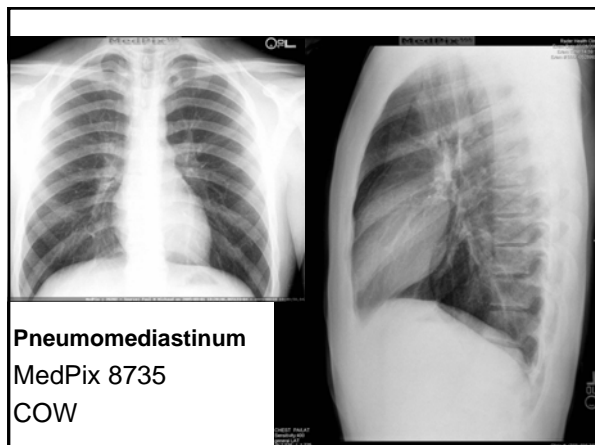






## Case: Lateral conclusive

- Demographics:
  - 15 y.o. boy
- History & Chief complaint:
  - Choked on pizza crust earlier in the day
  - Now with pain on inspiration



## Summary

- PA Lung: Markings, fissures
  - Mediastinum
  - Airways
  - Hila
  - Soft Tissues
  - Lateral
  - Bones
- Open TurningPoint,
    - Open Chest Quiz Fund II
  - Use following slides/ images and questions for template:
    - Next slide

## Summary

- Terms Frequently Used and Misused
- Visibility of shadows, edges, lines, etc.
- Normal Lung
  - Markings
- Demystifying the Lateral View
- Airway anatomy
- Next: More detailed normal anatomy